1903
B62

BLOCK

Tests of Brick from Street Pavements

Civil Engineering
B. S.

1903

UNIVERSITY
OF
ILL. LIBRARY

Learning and Labor.
LIBRARY
OF THE
University of Illinois.
CLASS. BOOK. VOLUME.
1903 B62
Accession No.

1260/2 copy 1

TESTS OF BRICK

FROM

STREET PAVEMENTS

BY

EDGAR WILLIAM BLOCK

THESIS

FOR

DEGREE OF BACHELOR OF SCIENCE

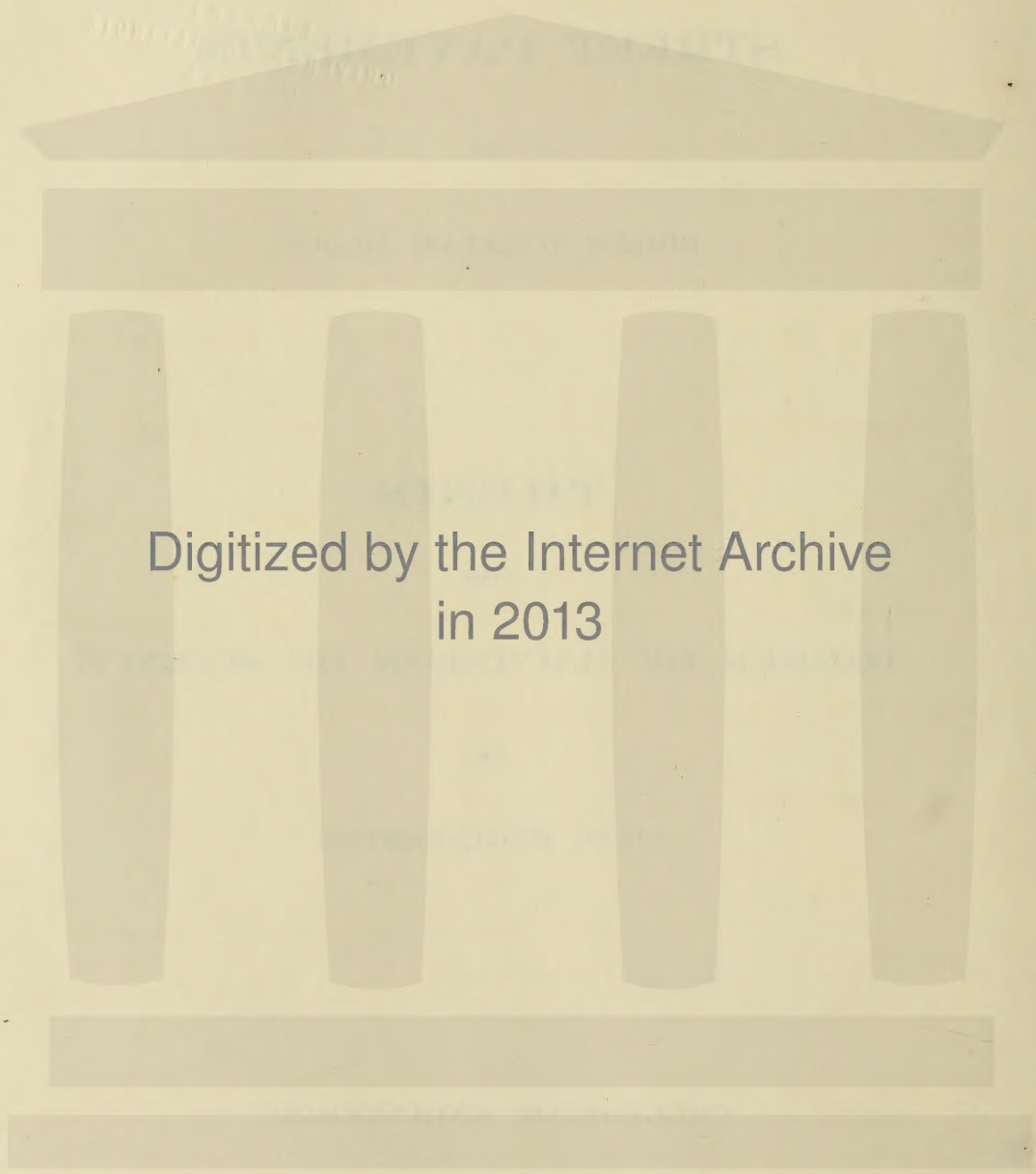
IN

CIVIL ENGINEERING

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

PRESENTED JUNE 1903



Digitized by the Internet Archive
in 2013

http://archive.org/details/testsofbrickfrom00bloc

UNIVERSITY OF ILLINOIS

June 1, 1903

This is to certify that the thesis prepared under the supervision of Professor Talbot by EDGAR WILLIAM BLOCK, entitled TESTS OF BRICK FROM STREET PAVEMENTS, is approved by me as fulfilling this part of the requirements for the Degree of Bachelor of Science in Civil Engineering.

Ira O. Baker.

Head of Department of Civil Engineering.

61523

B62

Tests of Brick from Street Pavements.

The testing of brick for pavements has been discussed quite widely and various methods of determining the quality of the material have been used. Some of these tests have been misleading and the wide diversity of practice and the many absurd requirements and specifications have long shown both the engineer and the manufacturer the desirability of a general adoption of methods of testing paving brick which shall fairly and clearly distinguish durable and suitable brick and reject poor and defective material.

Probably the most important quality of paving brick is uniformity, not necessarily uniformity in absorption of water, not uniformity of crushing strength, nor specific gravity, but uniformity of resistance to wear of the kind produced by traffic.

The next important quality of paving brick is that they shall have toughness to

The Rare Book & Manuscript Library
UIUC

resist the blows from horses hoofs and the wheels of vehicles. Hardness is not as necessary a quality since most forces which act upon a pavement are due to impact rather than abrasion.

In selecting a method of testing brick one should be taken which most nearly approaches the conditions of actual service. This has been granted to be a rattler test. The older tests of cross-breaking, crushing and absorption are not now generally used by brick testers.

City engineers have been somewhat slow to adopt the National Brick Makers Association rattler, perhaps better known as the Standard rattler, as a machine for testing brick for two reasons, because further investigation seems to show that tests made with this machine are not always reliable nor as satisfactory perhaps as those made with the modified form known as the Talbot-Jones machine, and because of lack of facilities for performing such tests.

The object of this thesis will be to compare tests made with the Talbot-Jones Rattler and the National Brick Makers Association

Standard Rattler upon different kinds of brick which have been taken from pavements and to give some idea of rattler losses which may be accepted for paving specifications. For a detailed discription of the two rattlers see the thesis of C. W. Malcomb '02 on "Comparison of the Talbot-Jones and the N. B. M. A. Standard Rattler Tests of Paving Brick".

Charge and Speed.

Talbot-Jones Rattler - The charge of brick used in the Talbot-Jones rattler varied all the way from 25 to 30 depending upon the size. The spacing between brick was about $\frac{1}{4}$ inch or equal to the spacing which would be formed by a uniform spacing of the number of brick which would fill the rattler without spacers less one. The charge of cast iron shot used consisted of 30 pounds of $2\frac{1}{2}$ inch cubes which weigh about $3\frac{1}{2}$ pounds each and 45 pounds of $1\frac{1}{2}$ inch cubes which weigh about $\frac{8}{10}$ of a pound each. The individual cubes were removed and replaced by new ones after they had lost one tenth of their original weight. The speed which was used throughout the entire tests was 36 revolutions per minute. This speed and charge

are for the standard recommended by Messrs. Habermeyer and Rightor, U. of I. '03.

Standard Rattler - With the standard rattler a charge of 9 or 10 brick and 300 pounds of cast iron shot were used. The shot used in this rattler consisted of 225 pounds of small cubes, 1½ inch as used in the Talbot-Jones rattler and 75 pounds of rectangular blocks 2½ inches square by 4½ inches long which weigh about 7½ pounds each. The individual shot were replaced by new ones as soon as they had lost one tenth of their original weight. The speed was about 30 revolutions per minute, the rattler being run for 1800 revolutions.

Method of Making Tests.

All tests made with the Talbot-Jones rattler were run for 6000 revolutions, the brick being removed after 3000, 4500 and 6000 revolutions respectively and weighed and loss calculated in per cent of original weight. The individual brick were replaced in the same order and with the same face exposed after each weighing. The brick were rattled with the best face exposed; i.e., in most cases the face which was down while

in the pavement. In order to avoid any large error and as a matter of checking the results the dust and chips were carefully collected and weighed as soon as the brick were removed. Tests made with the standard rattler were run 1800 revolutions after which brick were removed and loss calculated in percentage of original weight. The number of revolutions of the rattling chamber was recorded by a counter, one of which is attatched to each machine, and checked by taking the time of the test. The sharp edges of the large cast iron blocks were worn off before they were used in any of the tests.

Kind and Condition of Brick

All brick used in these tests have been taken from street pavements, where they have been in actual service varying in time from 7 months to 12 years for the different kinds of brick. Something is known of the quality of these brick and the amount and character of the traffic which they were subjected to, which will be given under the separate tests. All brick were thoroughly cleaned and dried before being tested. The brick received from Columbus Ohio were obtained

through the courtesy of Julian Griggs, Chief Engineer of Public Improvement, of that city. The brick from Champaign were obtained through the courtesy of W.H. Tarrant, City Engineer.

Poston Block - These brick, also known as Veedersburg brick, were taken from the pavement in Champaign, Illinois, on Walnut street just north of Main street, where they have been in rather light traffic for four years. The brick were laid in November 1898 and were taken up for the purpose of this test in November 1902. About 60 brick were removed from one spot which seemed to show normal wear. These the writer separated into two classes: Poston Block fair quality are those which showed little or no chipping. Poston Block poorer quality are those which showed considerable chipping. Most of these were chipped to the groove. However, it must be borne in mind that the brick are of the same general quality.

Harris Hallwood Block - These brick were taken from the pavement in Columbus, Ohio, from Wall street north of Long. The street from which they were taken is narrow and the traffic is only moderate or light, although in

in the central part of the city. They had been in service for 12 years having been laid in 1890 and being taken up for the purpose of this test in November 1902. They are considered fair material by Mr. Griggs although they seem to have worn down considerably and rather irregularly.

Nelsonville Hallwood Block - These brick are considered by Mr. Griggs to be as good or the best material that has ever been laid in Columbus Ohio. They were manufactured by the Nelsonville Sewer Pipe Co. and were taken from the south side of the intersection of Third and State streets. They have been in service for seven years having been laid in 1895 and being taken up for the purpose of this test in November 1902. The intersection from which these brick were taken adjoins the post office and has a heavy and continuous traffic on Third street of drays to and from the commission and other business houses. Third street on either side of this intersection is stone block pavement. The intersection is now in excellent condition. The brick show very little wear or chipping.

Nelsonville Block – These brick were taken from the pavement on the north side of Broad street between Frank and Mitchell, in Columbus, Ohio. They were laid in april 1902 and were taken up in November 1902 because they were found to be a soft and defective lot of brick. They seem to be uneven in wear, brittleness and softness, but not to be a very poor brick. About two car loads of this material was received and laid on account of careless inspection. The manufacturer furnished at his own cost new brick in place of the same and paid all of the expense of repaving.

Clinton Brick - These brick were taken from the pavement on west University avenue, just west of Neil street, Champaign, Illinois. They were in service for three years being laid in 1899 and being taken up for the pupose of test in November 1902. During this time they were subjected to a rather light traffic on a residence street. They are considered as fair material. The sample for tests were secured by taking about 60 brick from one spot which seemed to show normal wear. The writer separated these

brick into two classes in the same manner that the Poston Block were separated. Clinton Block, fair quality are those which showed little or no chipping while in the street. Clinton Block, poorer quality, are those which showed considerable chipping. This chipping generally extended down to the groove.

Tests with Talbot-Jones Rattler

Table I shows the result of tests with the Talbot-Jones rattler on various kinds of brick after running 3000, 4500 and 6000 revolutions. After a careful consideration, the writer concludes that 6000 revolutions gives results which correspond most nearly to the wear which was produced by traffic and is less liable to be affected by accidental conditions and should therefore be adopted as a standard. For 3000 revolutions the difference in wear of the brick is not so great as with 6000 revolutions. This may be due to the fact that the outside surface of brick is more uniform; i.e., a brick may be soft and defective inside and still have a hard and durable surface on the outside.

Tests with the N. B. M. A. Standard Rattler.

Three tests were made with the standard rattler on brick from Columbus Ohio with the following results:- Harris Hallwood Block 24.16 per cent; Nelsonville Hallwood Block 10.69 per cent; and Nelsonville Block 25.04 per cent. The writer did not test the other brick given in Table I with this rattler on account of lack of time but has secured results of tests on brick of similar quality from other experimenters which it is thought will enable a comparison to be made, and which will be inserted elsewhere in this thesis.

Comparison of Tests

In comparing the tests, it must be admitted that the standard rattler losses with the brick from pavements are somewhat less than would be the case with new brick, and the amounts for the Columbus brick with the standard rattler are therefore somewhat low. The Harris Hallwood Block is $2\frac{5}{8}$ inches thick, and its loss in both rattlers would be more than would be the loss of a block 3 inches or more in thickness as were the others. At a guess, this difference

in thickness would reduce the loss in the Talbot-Jones rather to about 9 per cent. The filler used in the Columbus pavements evidently protected the brick and aided in preserving the Harris Hallwood Block.

From the general appearance of the brick as taken from the street, a comparison of the traffic in the several streets, and the results of the several tests, the following statements of the quality of the several brick may be made. The Nelsonville Hallwood Block is an excellent quality of paving brick, perhaps as good a case be obtained. The Harris Hallwood Block is an uneven (soft or brittle) brick, and would not now be considered acceptable for any but the lightest traffic. Its fair condition must have been largely due to its being well laid and to its having a good filler. The Nelsonville Block is not a good brick but seems to be better than the Harris Hallwood Block. The better Clinton brick is of excellent quality, but the poorer grade is objectionable, showing that the brick as laid in the pavement were quite uneven. The Poston Block are fair, but will not stand heavy traffic.

A summary of the tests made with the Talbot-Jones rattler and the standard rattler is given in Table II. An inspection shows that the Talbot-Jones rattler makes a greater distinction between poor and good brick than does the standard rattler. Brick number 3 and 4 of Table II represent the poorest and best brick of the entire lot tested. According to the Talbot-Jones rattler the ratio of their wear is as 10.59 : 2.67 or as 4 to 1. With the standard rattler this ratio is as 24.16 : 10.69 or as 2.3 : 1 This shows that the difference in wear of the two kinds of brick with the Talbot-Jones rattler is nearly twice as much as with the standard rattler.

The results obtained with the standard rattler by other experimenters for brick similar to the two grades of Boston Block range from 19 to 25 and for Clinton from 21 to 25. It will be seen that this range is small, and accidental conditions may overcome this difference. The best Clinton shows less than half as much wear as the poor quality. The appearance of the two grades of Boston Block as well as the appearance of

their wear in the Talbot-Jones rattler indicates that there is not much difference in the two classes.

It should be noted that the face of the brick subjected to test in the Talbot-Jones rattler gave very similar appearance in wear and chipping to that of the face exposed to street traffic. In fact, this was quickly noticed by all observers. It also uncovered flaws which were hidden under the surface. Other properties could be noted which verify the statement, that the Talbot-Jones rattler makes a greater distinction between poor and good brick than does the standard rattler.

The writer regrets that the circumstances connected with the carrying out of his experimental work made duplication of tests impracticable, but he thinks that the weighing of chips and dust and the insertion of the bricks three times acted to minimize error and that the results are trustworthy.

In conclusion, from a study of the tests made, the writer would recommend that the Talbot-Jones rattler be made the standard

machine for testing paving brick. It should be run for 6000 revolutions with a speed of 36 revolutions per minute. This machine has the disadvantage of requiring more time to load than the standard rattler but the wear in the rattler is more nearly like that produced in the pavement. The great advantage when run under the conditions described above is that it makes a greater distinction between poor and good brick than does the standard rattler, a matter of the greatest importance.

As tentative values, the writer proposes the following limits of loss for 6000 revolutions with the Talbot-Jones machine: For heavy traffic 3 per cent; for moderate traffic 4½ per cent; and for light traffic 6 per cent.

TABLE I

Talbot - Jones Rattler Tests

Ref. No.	Kind	Loss in per cent of original weight			
		1500 rev.	1500 rev.	1500 rev.	Total 6000 rev.
1	Poston Block (Fair quality) Walnut St. Champaign 4 years service	2.61	1.21	1.06	4.88
2	Poston Block (Poor quality) Walnut St. Champaign 4 years service	2.69	157	1.55	5.81
3	Harris Hallwood Block Wall St. Columbus 12 years service	5.64	2.74	2.21	10.59
4	Nelsonville Hallwood Block Third & State Sts. Columbus 7 years service	1.09	.61	.97	2.67
5	Nelsonville Block Broad St. Columbus 7 months service	2.73	1.66	2.12	6.51
6	Clinton Block (Fair quality) W. University Ave. Champaign 3 years service	1.61	1.06	.70	3.37
7	Clinton Block (Poor quality) W. University Ave. Champaign 3 years service	4.57	1.96	1.77	8.30

TABLE II

Tests of Brick from Street Pavements

Ref. No	Name	Location	years in service	Traffic	Filler	Wear	U.-J. Rattler Test 6000 rev.	Standard Rattler Test
1	Poston Block (Fair quality)	Champaign Walnut St. north of Main St.	4	Light business traffic	Sand	No chipping Little wear	4.88	Estimated to be 19 to 25
2	Poston Block (Poorer quality)	"	4	"	Sand	Chipped to groove	5.81	
3	Harris Hallwood Block (fire clay)	Columbus O. Wall St. north of Long	12	Business street Moderate or light	Tar	Considerable + irregular	10.59 * [9.00]	24.16
4	Nelsonville Hallwood Block (fire clay)	Columbus O Third & State Sts.	7	Business street Heavy & continuous	Tar	Little	2.67	10.69
5	Nelsonville Block (fire clay)	Columbus O. Broad St. between Frank & Mitchell	7 mo.	Not known	Tar	Considerable	6.51	25.04
6	Clinton Block (Fair quality)	Champaign W. University Ave. West of Neil St.	3	Residence street Light traffic	Sand	No chipping Little wear	3.37	Estimated to be 21 to 25
7	Clinton Block (Poorer quality)	"	3	"	Sand	Chipped to groove	8.30	

* Reduced value on account of smaller thickness of block.

TABLE III

Tests of Harris Hallwood Block

Brick No.	Wt. at Start	Wt. after 3000 rev.	Wt. after 4500 rev.	Wt. after 6000 rev.
1	7# - 13½ oz	7# - 6½ oz	7# - 3 oz	7# - 0 oz
2	7 - 14½	7 - 8	7 - 5½	7 - 4
3	6 - 11	6 - 5½	6 - 3	6 - 1
4	6 - 15	6 - 7	6 - 4½	6 - 2
5	6 - 9	6 - 1½	5 - 14½	5 - 12
6	6 - 8	6 - 4	6 - 2½	6 - 0
7	7 - 15	7 - 11½	7 - 7½	7 - 5½
8	7 - 4	7 - 0½	6 - 14	6 - 13
9	7 - 4	7 - 0	6 - 13	6 - 10
10	8 - 0	7 - 14½	7 - 14	7 - 12½
11	7 - 11	7 - 7	7 - 4	7 - 0
12	6 - 7½	6 - 5½	6 - 4	6 - 3
13	7 - 5½	7 - 3	7 - 1½	6 - 15½
14	6 - 5	6 - 1	6 - 0	5 - 15
15	6 - 13	6 - 6	6 - 4	6 - 1½
16	7 - 1½	6 - 12	6 - 10	6 - 8½
17	6 - 15½	6 - 4	6 - 0½	5 - 11
18	6 - 14½	6 - 6	6 - 3½	5 - 15½
19	6 - 14½	6 - 8½	6 - 7	6 - 4½
20	7 - 11	7 - 5	6 - 13	6 - 3
21	7 - 9	7 - 3	7 - 1½	7 - 0
22	7 - 11	7 - 1	6 - 14½	6 - 11
23	6 - 14½	6 - 1½	6 - 0	5 - 13
24	7 - 5½	6 - 8½	6 - 7	6 - 5½
25	6 - 12	6 - 2½	6 - 1½	5 - 15½
26	7 - 13	7 - 7	7 - 5	6 - 14½
27	7 - 8	7 - 1	6 - 10½	6 - 6½
28	7 - 12½	7 - 8	7 - 7	7 - 4½
29	6 - 12	6 - 8½	6 - 6	6 - 3½
30	7 - 0	6 - 10	6 - 7	6 - 3
Total	216 - 11½	204 - 8	198 - 9	193 - 12½

TABLE IV

Tests of Nelsonville Hallwood Block

Brick No	Wt. at Start	Wt after 3000 rev.	Wt. after 4500 rev.	Wt. after 6000 rev.
1	8# - 12 oz	8# - 11 oz	8# - 10½ oz	8# - 10½ oz
2	8 - 15½	8 - 13½	8 - 13	8 - 12
3	7 - 11½	7 - 8	7 - 7	7 - 6½
4	8 - 11½	8 - 10½	8 - 10½	8 - 9½
5	8 - 9	8 - 8	8 - 8	8 - 7½
6	8 - 12½	8 - 11½	8 - 11	8 - 10½
7	8 - 1½	7 - 15	7 - 14	7 - 14
8	8 - 9½	8 - 8	8 - 7½	8 - 6½
9	8 - 12	8 - 11	8 - 10½	8 - 10
10	8 - 11½	8 - 10	8 - 9½	8 - 8½
11	8 - 8	8 - 6½	8 - 6	8 - 5½
12	8 - 14½	8 - 13	8 - 12½	8 - 11½
13	8 - 13	8 - 12½	8 - 12	8 - 11½
14	8 - 11½	8 - 10½	8 - 9½	8 - 8½
15	8 - 9½	8 - 5½	8 - 3	8 - 0½
16	8 - 10½	8 - 9½	8 - 8½	8 - 8
17	8 - 10½	8 - 9½	8 - 8½	8 - 7½
18	8 - 3½	8 - 3	8 - 2½	8 - 2½
19	8 - 9½	8 - 8½	8 - 8	8 - 7
20	8 - 11	8 - 9	8 - 6	8 - 4½
21	8 - 5½	8 - 4½	8 - 4	8 - 3½
22	8 - 12	8 - 10½	8 - 10	8 - 8½
23	8 - 6½	8 - 5	8 - 4	8 - 3
24	8 - 8½	8 - 7	8 - 5½	8 - 4
25	8 - 9½	8 - 8½	8 - 8	8 - 7½
26	8 - 11	8 - 9½	8 - 8½	8 - 7
27	7 - 9	7 - 6½	7 - 4½	7 - 2½
28	8 - 7½	8 - 6½	8 - 6	8 - 5½
Total	239 - 5½	236 - 12½	235 - 5	233 - 12

TABLE V

Tests of Nelsonville Block

Brick No.	Wt. at Start	Wt. after 3000 rev	Wt. after 4500 rev.	Wt. after 6000 rev.
1	8# - 13 oz	8# - 11 oz	8# - 10 oz	8# - 9 oz
2	8 - 15	8 - 11½	8 - 9	8 - 2
3	9 - 11½	9 - 8½	9 - 8	9 - 5½
4	9 - 3½	9 - 0	8 - 15	8 - 13½
5	9 - 5	8 - 15½	8 - 12	8 - 5
6	8 - 9	8 - 2	8 - 0½	7 - 13½
7	8 - 12½	8 - 9	8 - 7	8 - 3
8	9 - 5	9 - 2½	9 - 0	8 - 9½
9	8 - 14	8 - 4	8 - 0½	7 - 11½
10	9 - 2	9 - 0	8 - 13	8 - 12
11	8 - 14	8 - 7½	8 - 2½	7 - 14½
12	9 - 6	9 - 4	9 - 3	9 - 1½
13	9 - 1½	8 - 12½	8 - 10½	8 - 8
14	9 - 2	9 - 1	9 - 0½	8 - 15
15	8 - 9½	8 - 7	8 - 5	8 - 3
16	9 - 3½	9 - 1	9 - 0½	8 - 15
17	8 - 15	8 - 12	8 - 11	8 - 8
18	9 - 0	8 - 9½	8 - 5	8 - 1
19	9 - 3½	9 - 1½	8 - 14½	8 - 10½
20	8 - 10	8 - 5	8 - 3	8 - 1
21	8 - 14	8 - 6	7 - 12½	7 - 9½
22	9 - 2	8 - 15½	8 - 13½	8 - 11½
23	9 - 4	8 - 15	8 - 12½	8 - 10½
24	8 - 12½	8 - 10	8 - 8½	8 - 3½
25	9 - 2½	8 - 14½	8 - 11½	8 - 9½
26	8 - 11	8 - 9	8 - 7½	8 - 6½
Total	234 - 9½	228 - 3	224 - 4½	219 - 5

UNIVERSITY OF ILLINOIS-URBANA
3 0112 086855365